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(54) **Vehicle security system**

(57) A vehicle security system comprises a control unit 14 for operating an engine immobilization system in response to receipt of a valid coded signal. A door lock can also be operated. A transmitter transmits the coded signal as a sequence of pulses of electromagnetic radiation which are amplitude modulated at a modulating frequency (Fig. 3b or 4), and a receiver includes an audio frequency filter arranged to pass signals having a frequency within a range including the modulating frequency. This allows the filtering out of high powered int rfering signals which are of the same radio frequency as used in the system, but which are not modulated at the same audio frequency. Alternatively the modulation could be continuous, using two frequencies, one at a time, so that the two carry the same data and either can provide the data at the receiver if the other is corrupted by interference. Two frequencies could be used simultaneously, for data and clock respectively. More than two frequencies could be used in a given sequence.

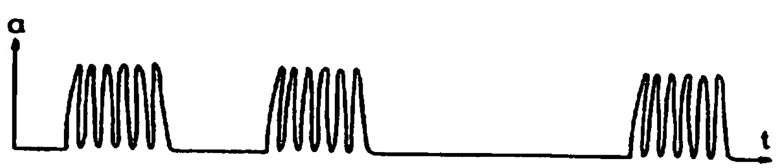

Fig. 3b

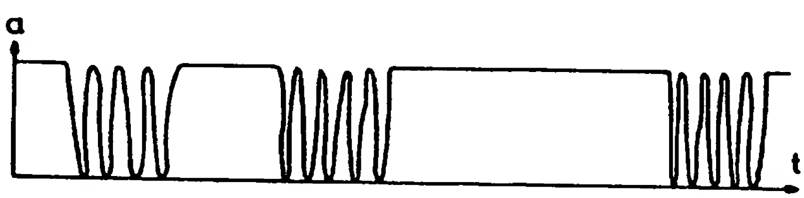

Fig. 4

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At least one drawing originally fil d was informal and the print reproduced here is taken from a later filed formal copy.

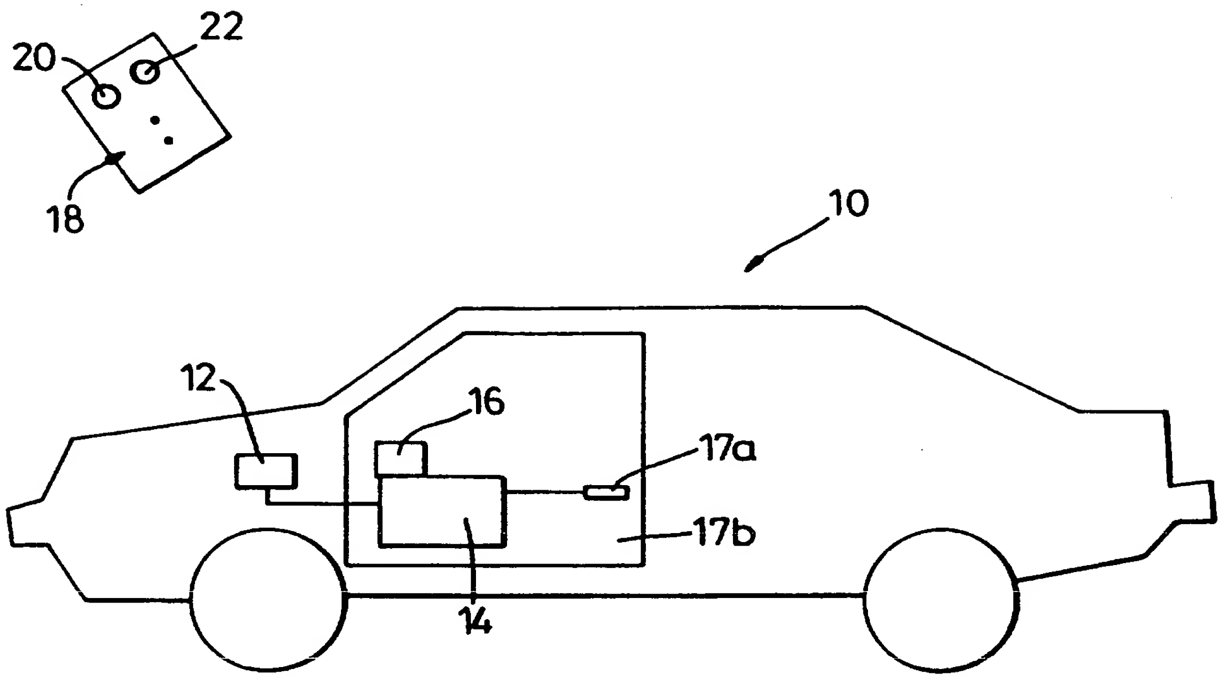

Fig. 1

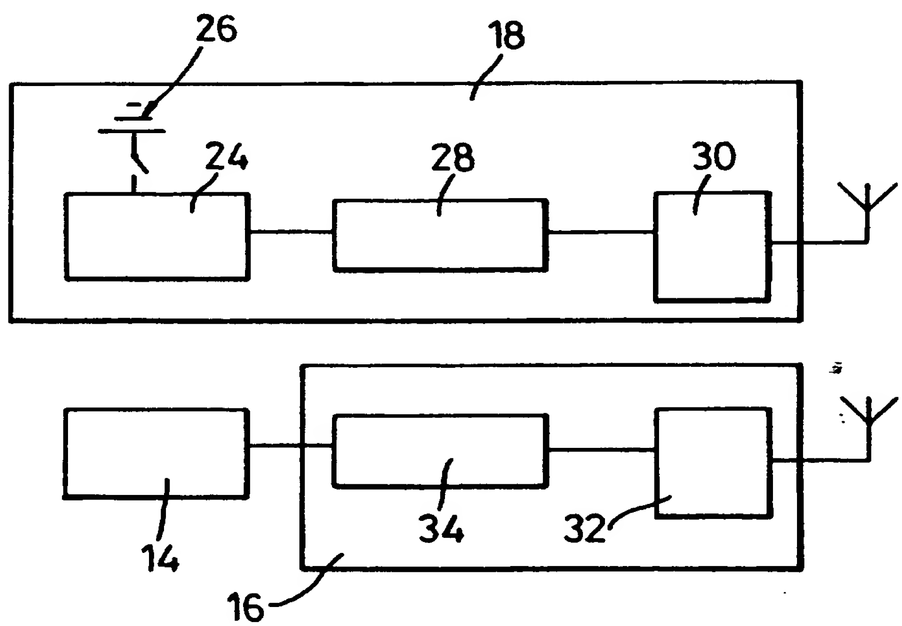

Fig 2

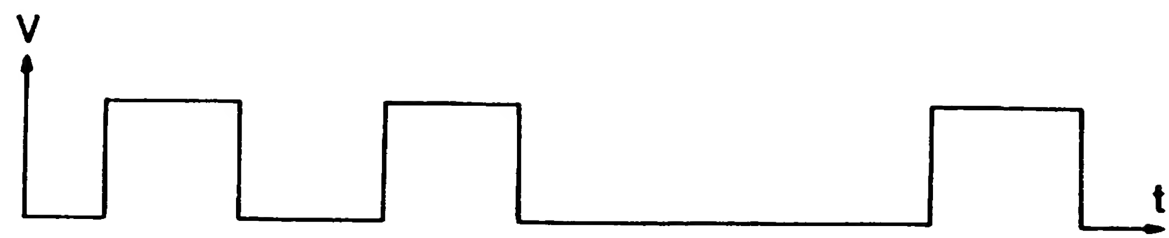

Fig. 3a

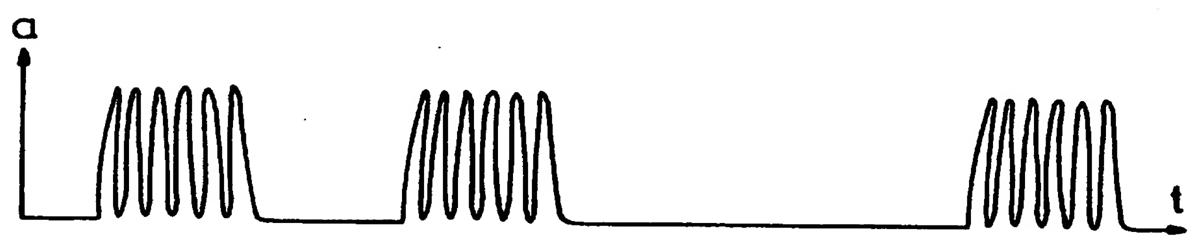

Fig. 3b

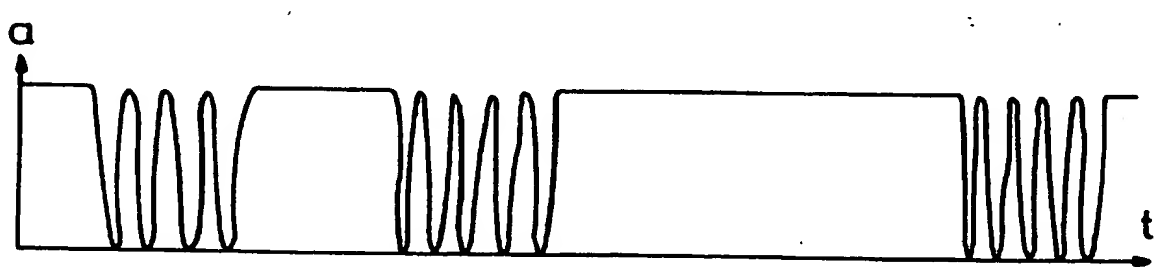

Fig 4

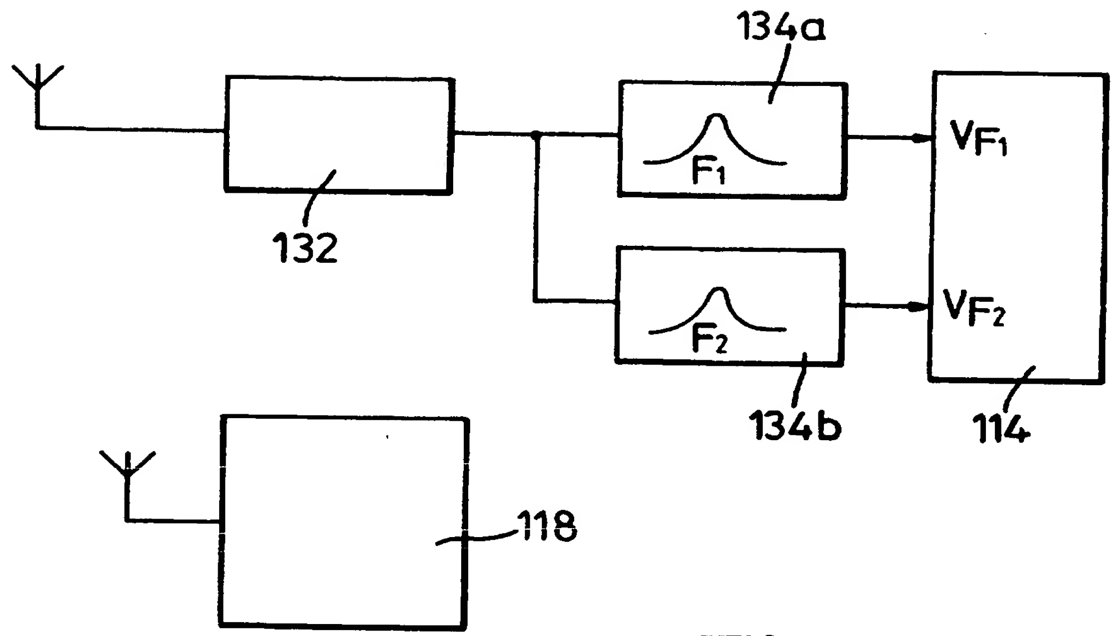

Fig. 5

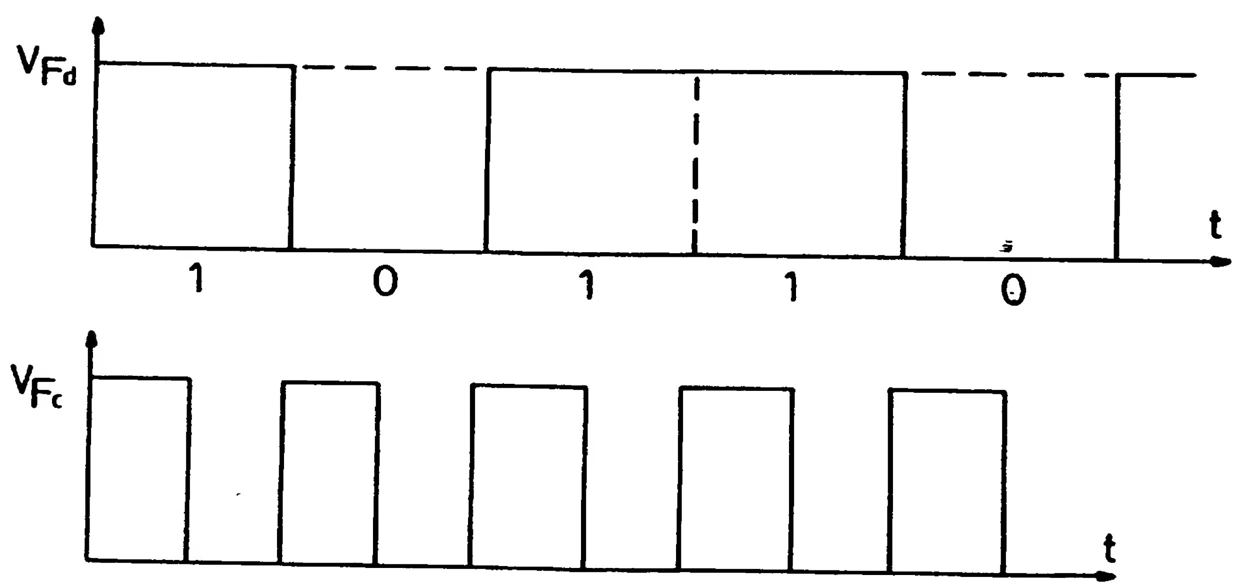

Fig. 7

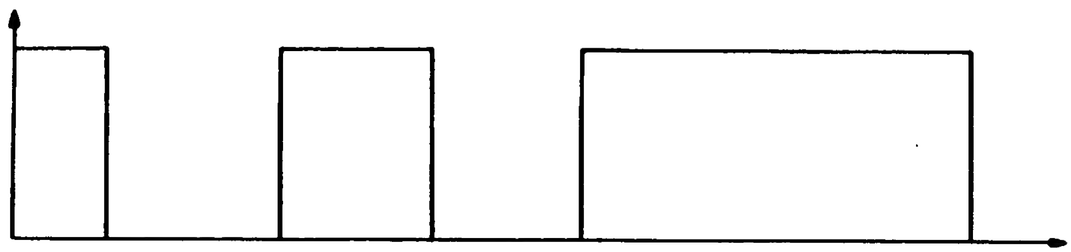

Fig. 6a

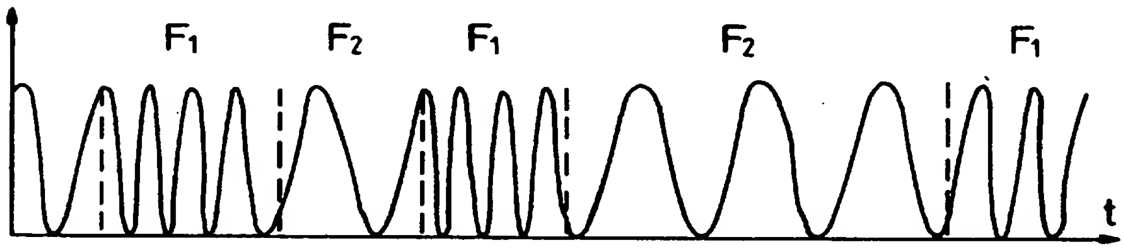

Fig. 6b

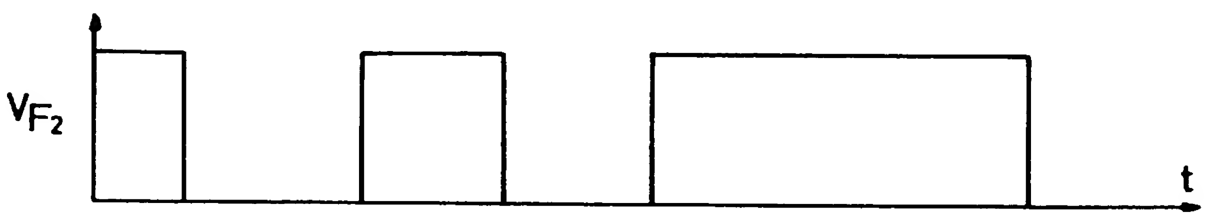

Fig. 6c

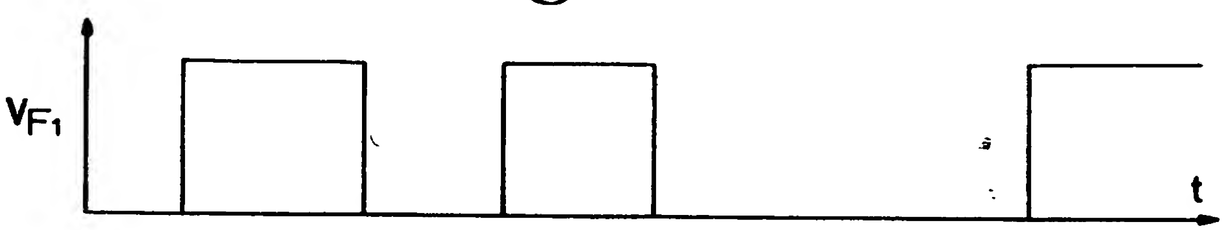

Fig. 6d

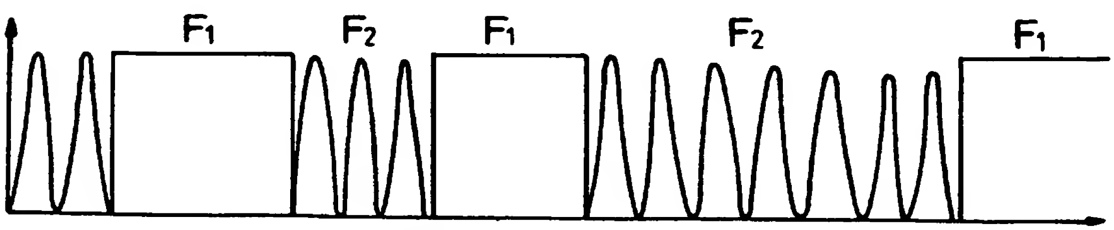

Fig 6e

A Vehicle Security System

The present invention relates to vehicle security systems which include a control means operated in response to the receipt of a coded signal transmitted from a transmitter.

One of the problems with vehicle security systems operated by radio frequency transmitters is that interference can affect the operation of the system. This is because the security systems are limited to relatively low power to maximize the life of their batteries, and the frequency used, which is governed by legislation in Europe, is also used by amateur radio operators and buildings security systems. These operate at much higher power outputs. However it is possible to identify ranges of audio frequencies of modulation, for example those above about 4 kHz, in which these interfering signals have very little or no content.

Accordingly the present invention provides a vehicle security system comprising a security component, a transmitter for transmitting coded radio frequency signals, receiving means for receiving said coded signals, and control means for operating the security component in response to receipt by the receiver of a valid coded signal, wherein the transmitter includes modulating means for producing amplitude modulation of the signal at a modulating frequency, and the receiving means includes filter means arranged to pass signals having an amplitude modulation frequency within a range including said modulating frequency.

Preferred embodiments of the invention will now be described by way of example only with ref rence to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a vehicle security system according to a first embodiment of the invention,

Figure 2 is a diagrammatic representation of the transmitter and receiver of the system of Figure 1,

Figures 3a and 3b show the signals produced by the transmitter of Figure 1,

Figure 4 shows an alternative form of signal to that shown in Figure 3b,

Figure 5 is a diagrammatic representation of a second embodiment of the invention, and

Figures 6a, 6b, 6c and 6d show signals produced in the system of Figure 5, and

Figure 6e shows a modification of the second embodiment of the invention,

Figure 7 shows the signals used in a third embodiment of the invention.

Referring to Figure 1, a vehicle 10 includes an engine management system operated by an engine control unit 12, and a security control unit 14 having a radio frequency receiver 16 connected to it. The security control unit can cause the engine control unit to immobilise the engine of the vehicl by cutting out the fu l supply and cutting out the power to th spark plugs. The security control unit can also operate a door lock 17a to lock and unlock a door 17b of the vehicle. A hand held battery powered transmitter

unit 18 is arranged to transmit coded radio frequency lock and unlock signals to the receiver 16 on pressing of lock and unlock buttons 20, 22.

Referring to Figure 2, the transmitter unit 18 comprises a code generator 24 powered by a battery 26, a modulator 28 and a radio frequency transmitter 30. The receiver means 16 includes a radio frequency receiver 32 and a band pass audio frequency filter 34 which passes a narrow band of frequencies around 20 kHz. The filter 34 is then connected to the security control unit 14.

The code generator produces a pulsed electrical signal of the form shown in Figure 3a comprising a coded series of pulses. The modulator 28 applies an amplitude modulation to the pulses at an audio frequency of 20 kHz. The modulated signal is shown in Figure 3b. The transmitter then transmits the amplitude modulated signal as electromagnetic radiation at a radio frequency of 433.92 MHz.

Referring to Figure 4, instead of the modulated signal comprising a series of amplitude modulated pulses with periods of zero signal between them, it can comprise a series of amplitude modulated pulses with a constant signal between them.

In the receiver unit 16, the transmitted signal is received by the receiver, passed through the filter 34 and then passed on to the control unit 14. The filter 34 therefore filters all signals received by the receiver 32 at 433.92 MHz, and only passes those which are amplitude modulated at around 20 kHz. The modulated signal from the transmitter th refore produces a pulsed signal from the filter 34 corresponding to that sh wn in Figure 3a. All other signals which might be picked up by th receiver, f r

example from amateur radio operators, which are not amplitude modulated at around 20 kHz, will be filtered out and will not interfere with the operation of the security system.

If the interfering signal is very highly powered it may saturate the front end of the receiver 16, swamping it with a signal of such magnitude that it cannot operate properly. This can prevent the coded signal from being recovered. In order to avoid this a limiter can be provided in the receiver to limit the power of the signal entering the audio frequency filter 34. The limiter may take the form of a F.E.T. device driven as an automatic gain control, or may simply comprise a pair of diodes.

The modulator 28 and filter 34 are both programmable, i.e. they can have their characteristics programmed by means of software so as to take different forms or so as to vary with time. The audio frequency modulation can therefore also be made to vary in frequency over time, for example by changing between two or more frequencies at regular time intervals. This can have two advantages. One is that, in the event that there is an interfering signal at one of the audio frequencies used, a change in audio frequency may allow the system to operate by filtering out the interfering signal. Another is that the audio frequency filtering can be used to increase the security of the system. It is known, as described for example in our international patent application published as WO 94/19219, to provide a vehicle security system in which the code incorporated in the coded signal changes at regular intervals, the transmitter and receiver being kept in synchronism. The same principles can be applied to the audio frequency modulation and filtering described above. The audi -frequ ncy of both the modulator 28 in th transmitter and the filter 34 in th receiver can easily be changed at desired intervals. It could therefore be arranged to cycle

through a series of frequencies at regular intervals. Alternatively the frequency selected at each change could be chosen according to an algorithm, common to the transmitter and receiver, which would introduce an element of randomness. Also the time intervals between frequency changes could vary with time in accordance with a common algorithm.

Referring to Figures 5 and 6, in a second embodiment of the invention, the transmitter unit 118, which corresponds to that in Figure 2, is arranged to transmit the pulsed electrical signal, shown in Figure 6a, as an RF signal which is continuous, having no gaps in it, but which comprises a series of parts of equal length, each of which is amplitude modulated at one of two frequencies F_1 and F_2, as shown in Figure 6b. The pulses or 'highs' of the pulsed signal are transmitted as RF signals modulated at the first frequency F_1, and the gaps between the pulses, or 'lows', are transmitted as RF signals modulated at the second frequency F_2.

The receiver unit of the second embodiment comprises an RF receiver 132, the output of which is fed to two parallel filters 134a and 134b which are band pass filters arranged to pass signals amplitude modulated at frequencies F_1 and F_2 respectively. The outputs from these filters are input to a control unit 114. The outputs from the filters 134a and 134b are shown in Figures 6c and 6d respectively, and it will be appreciated that one of them is the same as the pulsed coded electrical signal originally produced in the transmitter, and the other is the inverse of it. The control means is arranged to analyse the signals from each of the filters 134a and 134b and to read th data from one of the signals if the oth r has been corrupted. This means that, if there is interference at either of the frequencies F_1 or F_2, the signal from the unaffected filter 134a or 134b can still be used, and should not hav been corrupted. Such interference can occur, for example, where

there is an interfering RF signal, the radio frequency of which differs from that of the RF transmitter by a small amount, such that a beat frequency at F_1 or F_2 is produced.

A similar arrangement is shown on Figure 6e which corresponds to that shown in Figures 6a to 6d, except that one of the modulating frequencies F_1 is zero. This has the advantage that the two modulating frequencies are very far apart so it is particularly easy for the filters to distinguish between them.

Referring to Figure 7, in the third embodiment, the transmitter and receiver are the same as in the second embodiment, except that the transmitter can send separate signals at each of the modulating frequencies F_1 and F_2 . The signal modulated at F_1 is used as a data signal as shown in Figure 7a and that modulated at F_2 is used as a clock signal as shown in Figure 7b. The data signal is of a simple form being split into periods, each of which is either high, when a signal is present, or low, when no signal is present. The clock signal comprises a series of pulses, each of which is half the length of the data bits and is timed to end in the middle of one of the data bits. The output from the F_2 filter therefore has a series of falling edges which can be used by the control unit 114 to time the reading of the data bits output from the F_1 filter.

As a further development of the arrangement shown in Figure 7, it would be possible for each bit of the data signal to be amplitude modulated at one of two (or more) frequenci s. This would allow each bit to have three (or more) possible 'values' 0, 1 or 2, thereby enabling more complicated coding of the signal such as 'trinary' code. Again one of the modulating fr quencies can be zero.

CLAIMS

1. A vehicle security system comprising a security component, a transmitter for transmitting coded radio frequency signals, receiving means for receiving said coded signals, and control means for operating the security component in response to receipt by th receiver of a valid coded signal, wherein the transmitter includes modulating means for producing amplitude modulation of the signal at a modulating frequency, and the receiving means includes filter means arranged to pass signals having an amplitude modulation frequency within a range including said modulating frequency.

2. A system according to claim 1 wherein the filter means is a band pass filter.

3. A system according to claim 1 or claim 2 wherein the modulating means can produce amplitude modulation of the signals at either of two different modulating frequencies and the receiving means includes two filtering means each of which is arranged to pass signals having an amplitude modulation frequency at a respective one of said two frequencies but not the other.

4. A system according to claim 3 wherein one of the modulating frequencies is zero.

5. A system according to claim 3 or claim 4 wherein the transmitter is arranged to produce th coded signal by producing a continuous signal and modulating the whole of said continuous signal at a modulating frequency which alternates between said two modulating frequencies

such that when the receiving means receives the coded signal the output from each of said filtering means is the inverse of the other.

6. A system according to claim 5 wherein the control means includes analysing means for analysing the signals from each of the filtering means and is arranged to read one of said signals if the other has been corrupted.

7 A system according to claim 1 or claim 2 wherein the coded signal comprises a sequence of pulses of electromagnetic radiation.

8. A system according to claim 3 or claim 4 wherein the coded signal comprises a sequence of pulses of electromagnetic radiation and the modulating means is arranged to modulate each of the pulses at one of the modulating frequencies.

9. A system according to claim 3 or claim 4 wherein the coded signal comprises a series of code portions, each of which has a single modulation frequency and represents a single bit of a code, the value of which is defined by the modulation frequency.

10. A system according to claim 9 wherein the value of each bit is further defined by the presence or absence of a signal in the respective portion of the signal.

11. A system according to claim 3 or claim 4 wherein the transmitter is arranged to transmit a clock signal which is amplitude modulated at one modulating frequency, and a data signal which is amplitude modulated at at least one other m dulating frequency.

12. A system according to any foregoing claim wherein the or each modulation frequency is in the audio-frequency range.

13. A system according to any foregoing claim wherein the modulation frequency is higher than about 4 kHz.

14. A system according to any foregoing claim wherein the modulating frequency or frequencies of the transmitter and the frequency range or ranges of the filtering means are arranged to vary in time, in synchronism with each other.

15. A system according to any foregoing claim wherein the security component comprises an engine immobilizer.

16. A system according to any foregoing claim wherein the security component comprises a door locking mechanism.

17. A vehicle security system substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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Application No: GB 9701662.0
Claims searched: 1-17

Examiner: Mike Davis
Date of search: 18 February 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4H (HTG,HRCE,HRCK,HRCS)

Int Cl (Ed.6): B60R 25/00,04, E05B 49/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 94/06988 A1 (ROCKWELL) e.g. p.4 line 27 to p.5 line 2.	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.